

Welcome to NASA Applied Remote Sensing Training (ARSET) Webinar Series

Introduction to NASA Earth Science Data Products, Portals, and Tools

Course Dates: 16, 23, 30 September and 7, 14 October 2014



ATMOSPHERE



CALIBRATED RADIANCE AND
SOLAR RADIANCE



CRYOSPHERE



HUMAN DIMENSIONS



LAND



OCEAN

ARSET

Applied Remote Sensing Training
A project of NASA Applied Sciences



Important Information

Presentations URL:


<http://arset.gsfc.nasa.gov/>

Contact for Requesting Recorded Link for the Webinars:

Marines Martins : marines.martins@ssaihq.com

Past Presentations

<http://arset.gsfc.nasa.gov/>

**ARSET**
Applied Remote Sensing Training

Earth Science Division Applied Sciences ASP Water Resources

DISASTERS ECO FORECASTING HEALTH & AIR QUALITY WATER RESOURCES

ARSET


- Webinars
- Workshops
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- Personnel
- Links
- Upcoming Webinar

Upcoming Courses




Airquality, Disasters, Ecoforecasting, Water Resources [Introduction to NASA Earth Science Data Products, Portals, and Tools](#)
09/16/2014 to 10/14/2014

Introduction to NASA Earth Science Data Products, Portals, and Tools

09/16/2014 to 10/14/2014
Times: Tuesdays (5 one-hour sessions), 8-9 AM U.S. Eastern Standard Time (13 PM UTC)
GIS: True
Keywords: [Satellite Imagery](#), [Tools](#)
Instruments: [Aqua](#), [Landsat](#), [Terra](#), [TRMM](#)

 [Webinar Information](#)

Presentations and Recordings

Week	Date	Title	Presentation	Recording	Assignment
1	Sept. 16, 2014	NASA Earth Science: <i>Research and Applications to Decision Support</i>	 Session-1 (click)	View	N/A
2	Sept. 23, 2014	Overview of NASA Earth Science Data Products: Remote Sensing and Earth System Modeling Data	 Session-2 (click)	View	N/A
3	Sept. 30, 2014	NASA Data Centers and Data Access Tools	 Session-3 (click)	View	N/A

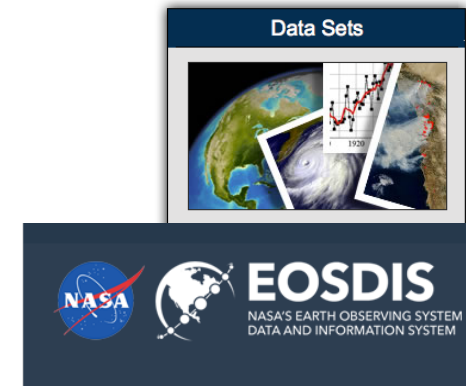
Course Outline

Week 1



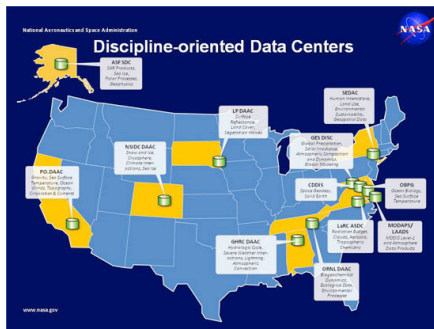
NASA Earth Science

Week 2



NASA Data Products

Week 3



NASA Data Centers

Weeks 4 & Week 5

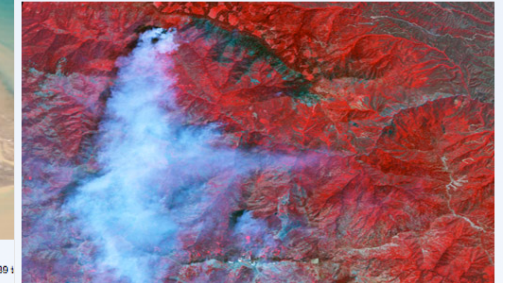
Application & Capacity Building: Application Areas

Water Resources



NASA's Landsat satellites shows the Yellow River delta at five-year intervals from 1989 to 2014.

Disasters



NASA supports California wildfire control efforts with an unmanned plane read more...

NASA Data Applications with GIS

Week 4 Outline

NASA Data for Air Quality Monitoring and Water Resources Management

Air Quality and Water Resources:

- Data Parameters
- Examples of Data Applications
- Live Demonstrations of:
 - *Monitoring Air Quality using **Worldview** and **Giovanni***
 - *Monitoring Rainfall over Nile River Basin and Monitoring Drought over Western US using **Giovanni***
 - ***GIS** Analysis of Nile River Basin Rainfall*

Air Quality Data and Applications

Air Quality

How measurements of Air Quality can be used by decision makers for the implementation of air quality standards, policy and regulations for environmental, economic and human welfare.

Pollution and Breathing



At risk. Studies with elderly volunteers have shown that slight changes in outdoor particle levels can change heart rate variability.

Industrial Air Pollution: Possible Effect on Lung Cancer

Abstract. Higher lung cancer mortality rates occurred in males living in certain heavily industrialized areas of Los Angeles County, California. These areas were characterized by elevated concentrations of benzo[a]pyrene and other polynuclear aromatic hydrocarbons of primarily industrial origin in the soil and air.

Industrial pollution linked to lung cancer

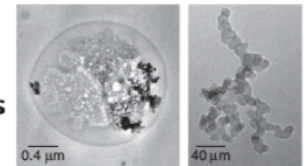
Pollution and Health

Air Pollution—Related Illness Effects of Particles

André Nel

Worldwide epidemiological studies show a consistent increase in cardiac and respiratory morbidity and mortality from exposure to particulate matter (PM) (1-3). PM is a key ingredient of polluted air and is estimated to kill more than 500,000 people each year (4).

Enhanced online at
www.sciencemag.org/cgi/content/full/308/5723/804



Dangerous dirt. (Left) Electron micrograph of a fine mode particle collected by an impactor from air outside an engineering laboratory at the University of California, Los Angeles. A halo surrounds residues of what are probably inorganic salts and polar organic compounds dissolved in the original aqueous droplet. Sootlike particles are also present. (Right) Aggregates of ultrafine particles collected on the last stage of an eight-stage impactor. These are soot particles emitted from diesel engine sources such as buses. More volatile particles may have evaporated in the electron microscope.

Increase in cardiac and respiratory illnesses

No boundaries for pollution

Global Air Pollution Crossroads over the Mediterranean

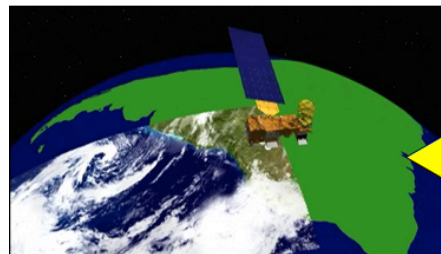
J. Lelieveld,^{1*} H. Berresheim,² S. Borrmann,^{1,3} P. J. Crutzen,^{1,4}
F. J. Dentener,⁵ H. Fischer,¹ J. Feichter,⁶ P. J. Flatau,^{4,7} J. Heland,⁸
R. Holzinger,¹ R. Kormann,¹ M. G. Lawrence,¹ Z. Levin,⁹
K. M. Markowicz,^{4,10} N. Mihalopoulos,¹¹ A. Minikin,⁸
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E. G. Stephanou,¹¹ P. Stier,⁶ M. Traub,¹ C. Warneke,¹⁵
J. Williams,¹ H. Ziereis⁸

The Mediterranean Intensive Oxidant Study, performed in the summer of 2001, uncovered air pollution layers from the surface to an altitude of 15 kilometers. In the boundary layer, air pollution standards are exceeded throughout the region, caused by West and East European pollution from the north. Aerosol particles also reduce solar radiation penetration to the surface, which can suppress precipitation. In the middle troposphere, Asian and to a lesser extent North American pollution is transported from the west. Additional Asian pollution from the east, transported from the monsoon in the upper troposphere, crosses the Mediterranean tropopause, which pollutes the lower stratosphere at middle latitudes.



Thus Monitoring...

Intercontinental transport



From Space



From Surface

Satellite Products for Air Quality Applications

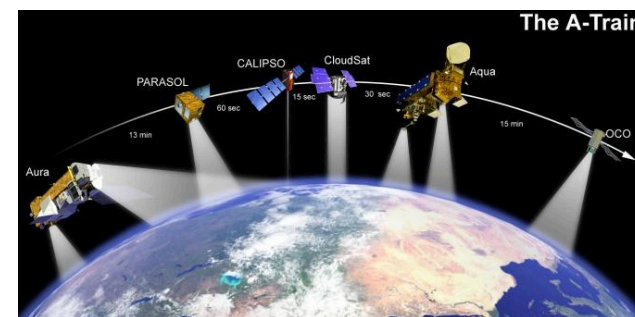
- **Particulate Pollution** (dust, haze, smoke)
 - Qualitative: Visual imagery
 - Quantitative*: Atmospheric Column Products
- **Fire Products:** Fire locations or 'hot spots'
Fire radiative power
- **Trace Gases**
 - Quantitative*: Column Products
 - Vertical profiles: mostly mid-troposphere
 - Some layer products

Satellite Products for Air Quality Applications

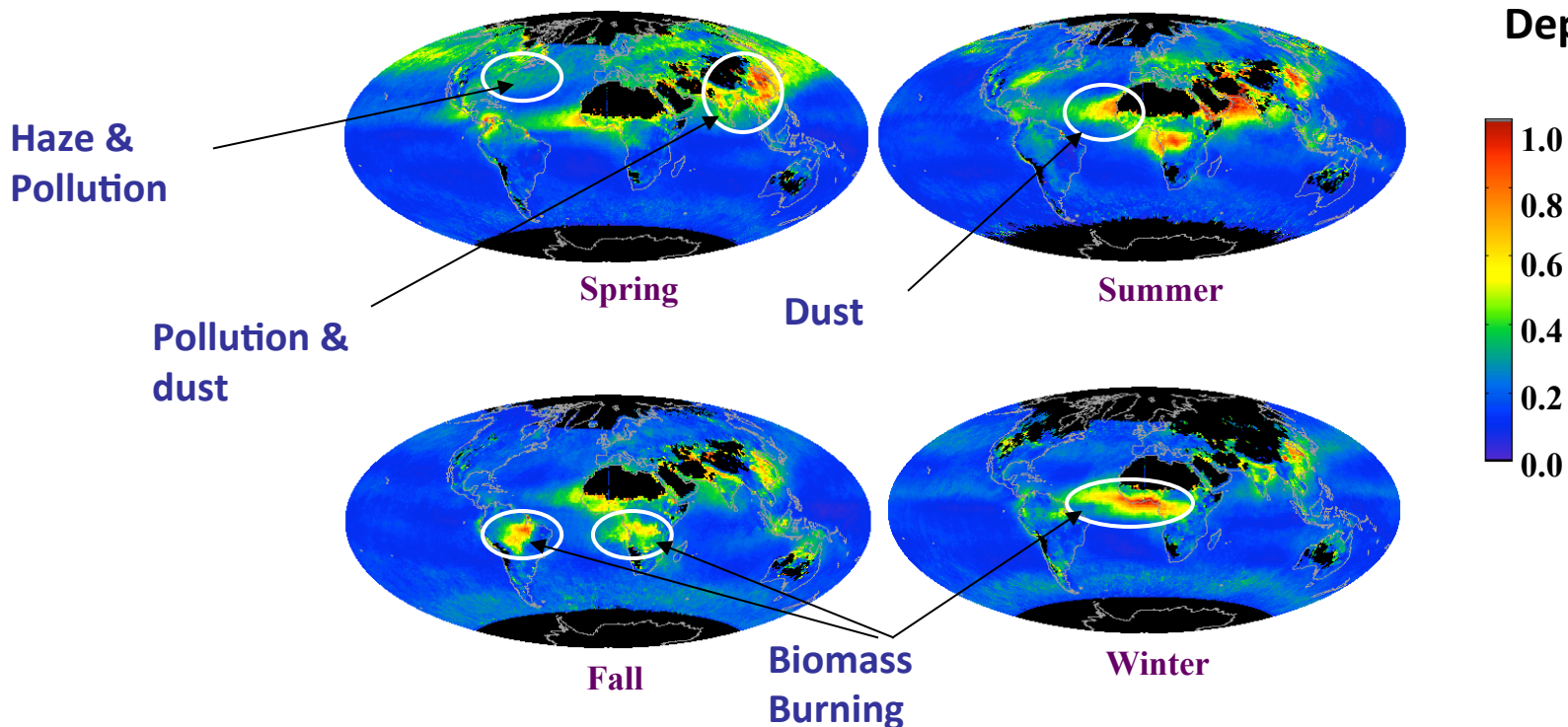
Particulate Matter (PM, dust, haze, smoke)

- also known as aerosols
- general term used for a mixture of solid particles and liquid droplets
- Natural (dust and volcanic ash) and anthropogenic aerosols (biomass burning smoke, industrial pollution)
- reduce visibility and induce respiratory diseases
- Particulate matter with particle diameters less than $2.5\mu\text{m}$ (PM_{2.5}) can cause lung and respiratory diseases and even premature death.

Some kinds of aerosol data available from satellite.



Aerosol Optical
Depth



Several satellites provide state-of-art aerosol measurements over global region on daily basis

Satellite Products for Air Quality Applications

Trace Gases (CO, NO₂, SO₂,)

Remote sensing of trace gases uses the signature of gas absorption at distinct absorption spectra.

By knowing how and by what amount different molecules absorb radiation at different wavelengths, we can identify a "fingerprint" for each atmospheric constituent and estimate physical measurements (such as number density, partial pressure, column amount) of the different gases.

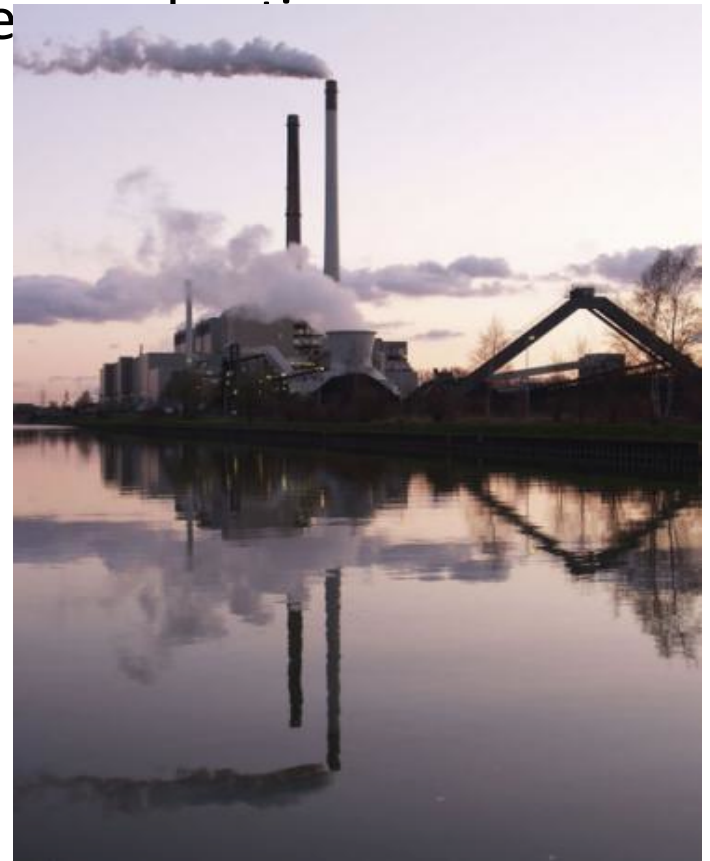
SO₂

- a precursor of sulfate acid (acid rain) and sulfate particle
- colorless gas with a suffocating, choking odor.
- toxic to humans
- primary from burning of coals (smelters, power plants)
- sometime from volcanic eruptions



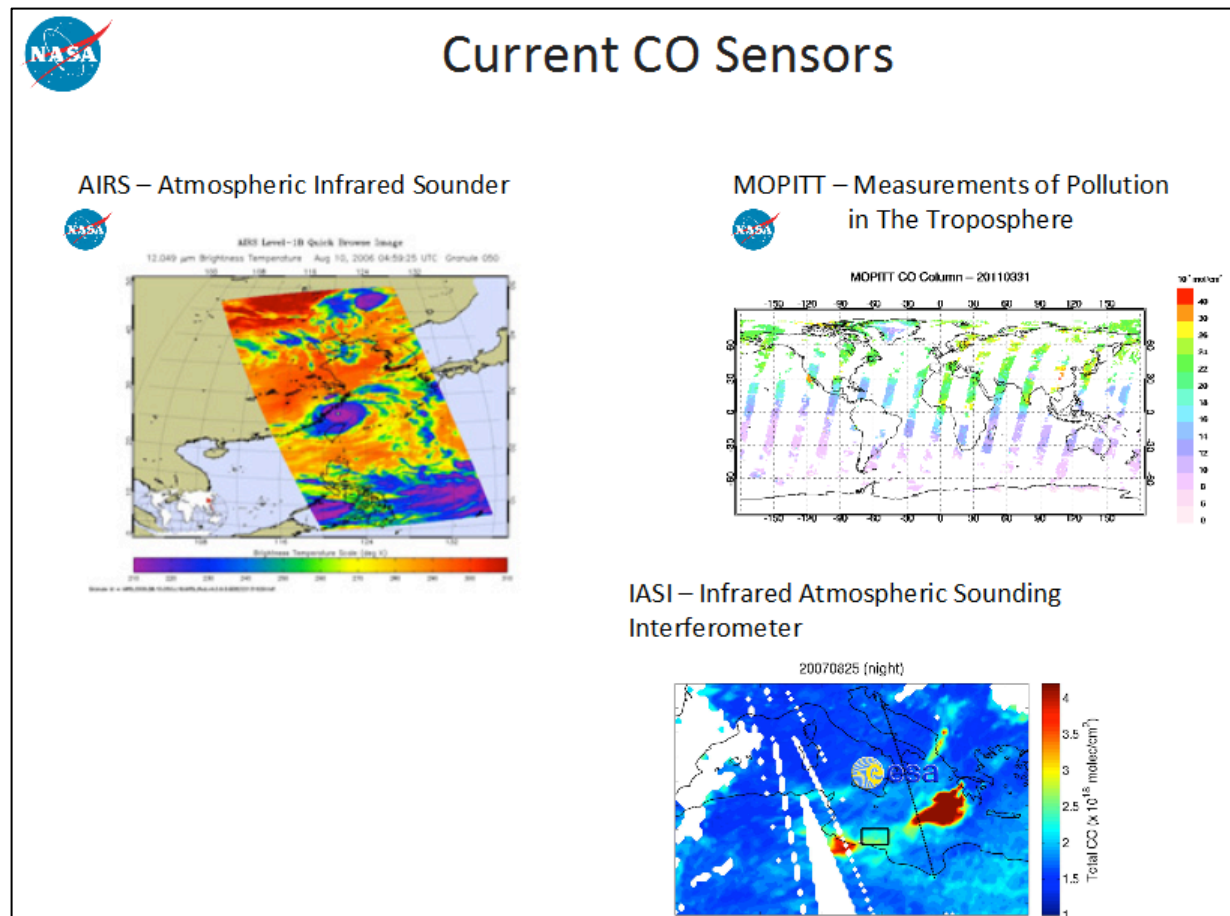
NO_2

- precursor of nitrate acid (causes acid rain)
- nitrate acid + ammonia nitrate particle particulate pollution
- Toxic
- primarily from vehicle exhaust and other combustion processes

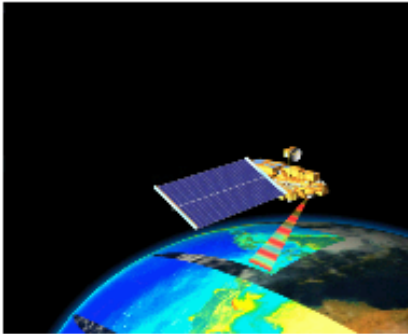


CO - Carbon Monoxide

- major component of air pollution, produced by fossil fuels, biomass burning,
- linked chemically to O₃
- an ideal 'tracer'
- highly variable geographically and temporally



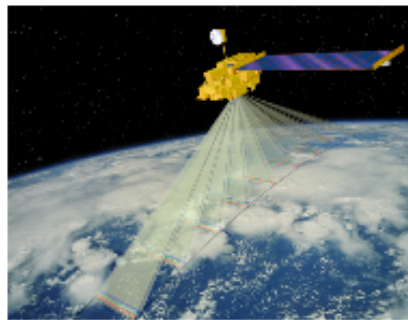
Primary Sensors - AEROSOLS



MODIS

MODerate resolution Imaging SpectroRadiometer

Measures total column aerosol
AOD - Aerosol Optical Depth



MISR

Multi-angle Imaging SpectroRadiometer

AOD
Particle Type

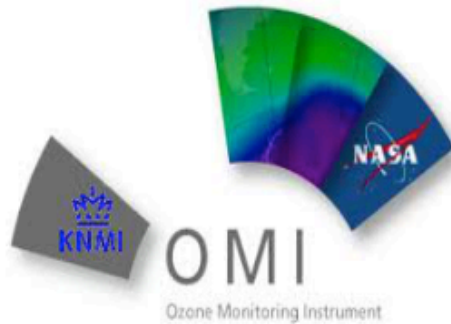


VIIRS

Visible Infrared Imaging Radiometer Suite

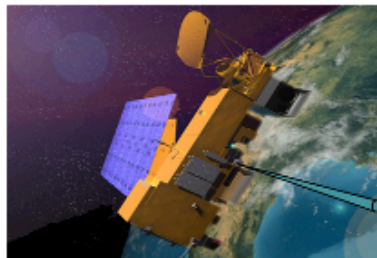
AOD
Particle Type

Primary Sensors – Trace Gases



OMI

Ozone Monitoring Instrument



AIRS

Atmosphere Infrared Sounder

Satellites/Sensors for Air Quality Parameters

Satellite	Sensors	Quantities
Terra and Aqua	MODerate Resolution Imaging Spectroradiometer (MODIS)	Aerosol Optical Depth (AOD)
Terra	Multi-angle Imaging SepctroRadiometer (MISR)	(AOD) Particle Type
Aqua	Atmospheric Infrared Sounder (AIRS)	Trace Gases
Aura	Ozone Monitoring Instrument (OMI)	Ozone, Sulphur Dioxide, Nitrogen Dioxide AOD
Suomi-NPP*	Visible Infrared Imaging Radiometer Suite (VIIRS)	Aerosol Optical Depth (AOD) Particle Type
CALIPSO	LIDAR	Aerosol Profile

*National Polar-orbiting Partnership

Who can benefit from NASA Air Quality data?

- ♦ **Policy makers**
- ♦ **Regulatory Agencies**
- ♦ **NGOs**

ARSET course topics include:

Case Studies in air quality analysis tailored to end-user needs, such as urban air pollution, dust, and fires.

Satellite aerosol and trace gas products, their application and relationship to in-situ monitor data.

Long Range Transport of atmospheric aerosols (or particulate matter) and trace gases.

Satellite and regional air quality model comparisons

Image Archive and Gallery Links

Worldview

<https://earthdata.nasa.gov/labs/worldview/>

MODIS Rapid Response Site

<http://earthdata.nasa.gov/data/near-real-time-data/rapid-response>

NASA's Visible Earth

<http://visibleearth.nasa.gov>

NASA's Earth Observatory

<http://earthobservatory.nasa.gov>

For further reading on Air Quality Applications:

ARSET: <http://arset.gsfc.nasa.gov/airquality/applications>

For further data access:

GIOVANNI : <http://disc.sci.gsfc.nasa.gov/giovanni>

EOSDISC Reverb global search tool: <http://reverb.echo.nasa.gov>

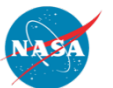
GES-DISC: <http://disc.sci.gsfc.nasa.gov>

Mirador Archive: <http://mirador.gsfc.nasa.gov>

Global Sulfur Dioxide Monitoring Homepage: <http://so2.gsfc.nasa.gov/>

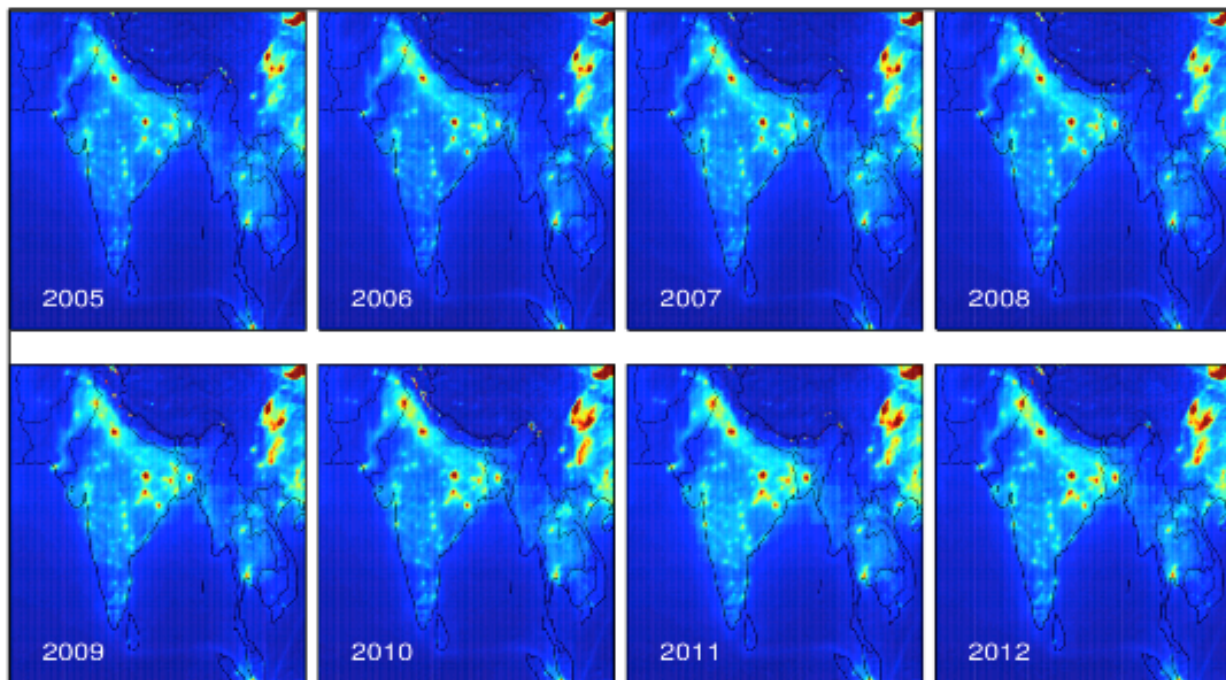
MODIS LAADSWeb: <http://ladsweb.nascom.nasa.gov/data/search.html>

Aura NO₂Data: <http://avdc.gsfc.nasa.gov>

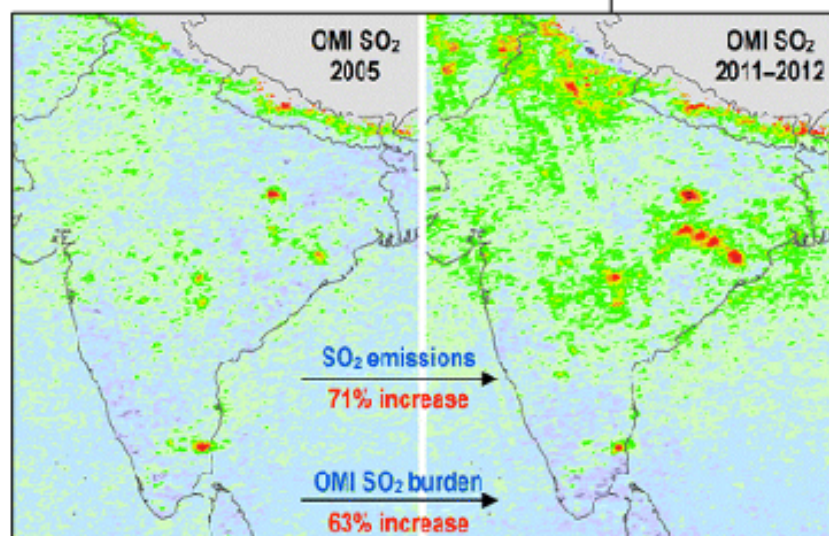


NO₂ & SO₂ from OMI

OMI NO₂ Trends



courtesy: Lok Lamsal

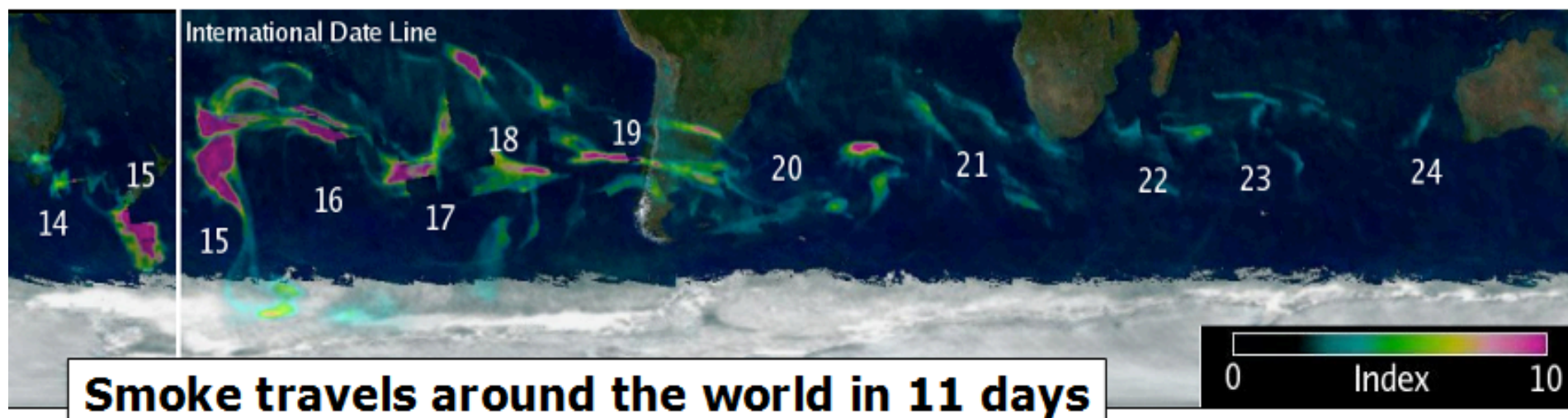
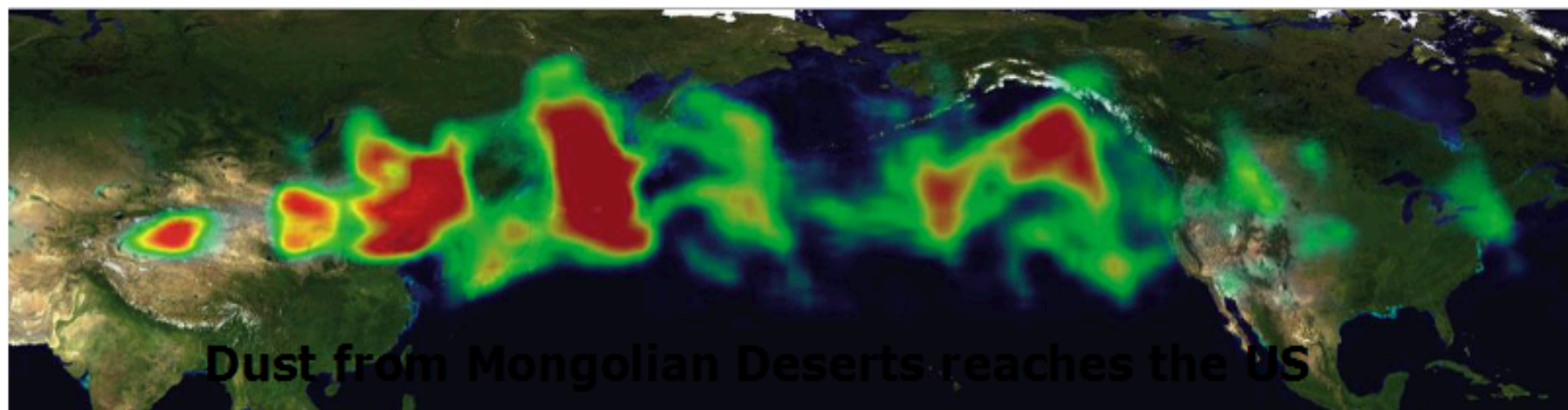


OMI SO₂ Trends

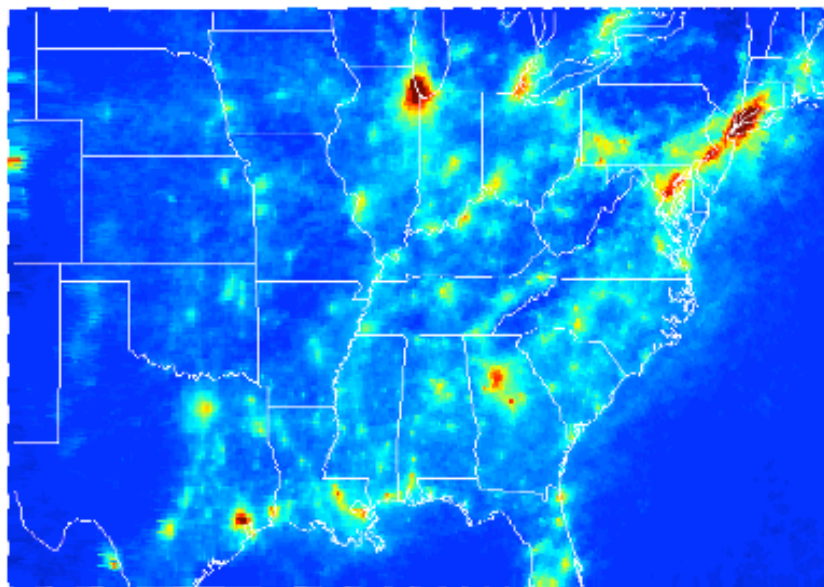


Lu et al., 2013

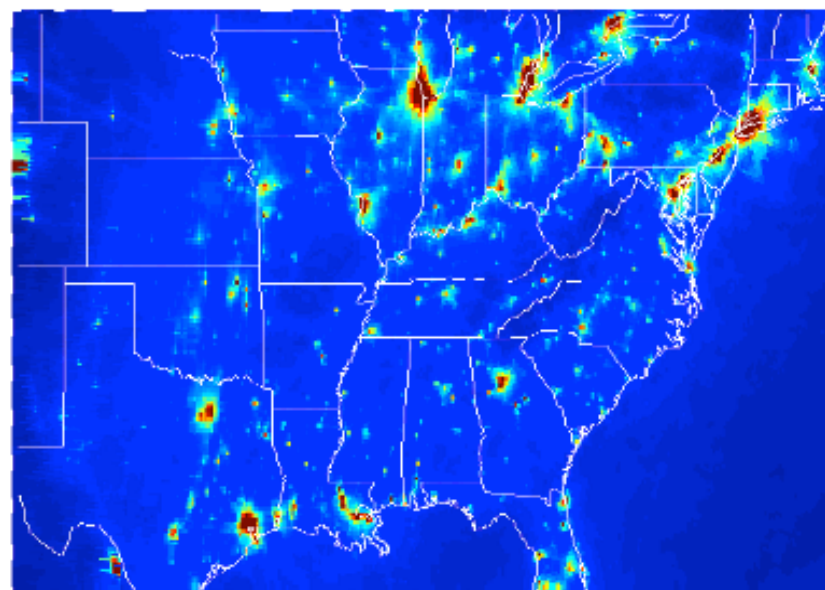
Long Range Transport



Model-Satellite Inter-comparison



CMAQ Model NO2



OMI NO2

GIS Data Layers

Rivers/Basins	USGS HydroSHEDS	http://hydrosheds.cr.usgs.gov/
Population	NASA Socioeconomic Data and Applications Center (SEDAC)	http://sedac.ciesin.columbia.edu/
Elevation	Consortium for Spatial Information (CGIAR-CSI)	http://srtm.csi.cgiar.org/
Reservoirs	NASA Socioeconomic Data and Applications Center (SEDAC)	http://sedac.ciesin.columbia.edu/
Soil Type	ISRIC - World Soil Information	http://www.isric.org/
Dams	NASA Socioeconomic Data and Applications Center (SEDAC)	http://sedac.ciesin.columbia.edu/
Global, National Administrative Areas	Global Administrative Areas	http://www.gadm.org/
Global Base Maps	ESRI Base maps	http://www.esri.com/data/basemaps

Live Demo
Air Quality Monitoring



Water Resources Applications



Water Resources Management

- Requires balancing Fresh Water availability and usage
- **Precipitation (rain, snow)** is the main source of Fresh Water – regionally, **stream flow, lakes, soil moisture, and ground water** also contribute to available Fresh Water
- **Evaporation and Evapotranspiration** contribute to the loss of water to the atmosphere and the depletion of available Fresh Water
- Fresh Water usage changes regionally according to population, agricultural, and industrial practices
- There is substantial spatial and temporal variability in these factors due to natural (e.g. weather and climate variability) and human-induced influences (e.g. climate change, land use, population change)

NASA Satellites and Earth Systems models provide global scale water Resources quantities on hourly, daily, seasonal, and multi-year time scales useful for water resources, flood, drought monitoring and management

- Rain
- Temperature
- Humidity
- Winds
- Soil Moisture
- Snow/Ice
- Clouds
- Terrain
- Ground Water
- Vegetation Index
- Evapotranspiration
- Run off

Fresh Water Components over Land

Rain amount

Snow/Ice, Snowmelt amount

Run off, Stream flow

Soil moisture

Evapotranspiration

Ground water

All these quantities are available from satellite observations as well as from models

Quantities in green are derived from satellite observations

Quantities in red are from land and atmosphere-land models in which satellite observations are assimilated

Satellites/Sensors for Disasters, Land and Water Resources Parameters

Satellite	Sensors	Quantities
Also: GPM - Global Precipitation Measurement mission (launched in February 2014) to improve TRMM precipitation SMAP – Soil Moisture Active Passive (to be launched in November 2014) to provide high quality soil moisture measurements		
Aqua	Atmospheric Infrared Sounder (AIRS)	3-dimensional Atmospheric Temperature and Humidity, clouds
	Advanced Microwave Scanning Radiometer for EOS (AMSR-E)	Snow Water Equivalent, Sea Ice, Soil Moisture, Rain Rate
Landsat	(Enhanced) Thematic Mapper (ETM)	Vegetation Index, Leaf Area Index, Land Cover
Grace	K-Band Ranging Assembly	Terrestrial Water

NASA Models Data

For Water Resources and land Management

Models	Quantities
MERRA	3-dimensional Winds, Temperature, Humidity, Clouds, Rain Rate ,Snow Mass, Snow Cover, Snow Depth, Surface Snowfall Rate, Evapotranspiration
GLDAS/NLDAS	Evapotranspiration, Multi-layer Soil Moisture, Rainfall, Snowfall Rate, Snow Melt, Snow-Water Equivalent, Surface and Sub-surface Runoff

Water Resources Data Usage and Applications

SERVIR: Regional Flood Monitoring System uses TRMM near-real time rainfall data in a hydrology model to identify flooding potential over Africa

<https://www.servirglobal.net/Africa.aspx>

Flood Monitoring
and Warning



Extreme Rain Detection System (ERDS) uses TRMM Rainfall

<http://www.ithacaweb.org/projects/erds/>

Provides information to UN-
World Food Program –
supporting humanitarian
operations



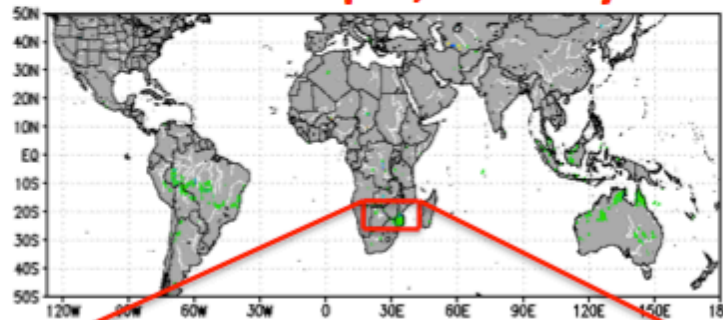
Global Flood Monitoring System (GFMS)

<http://flood.umd.edu/>

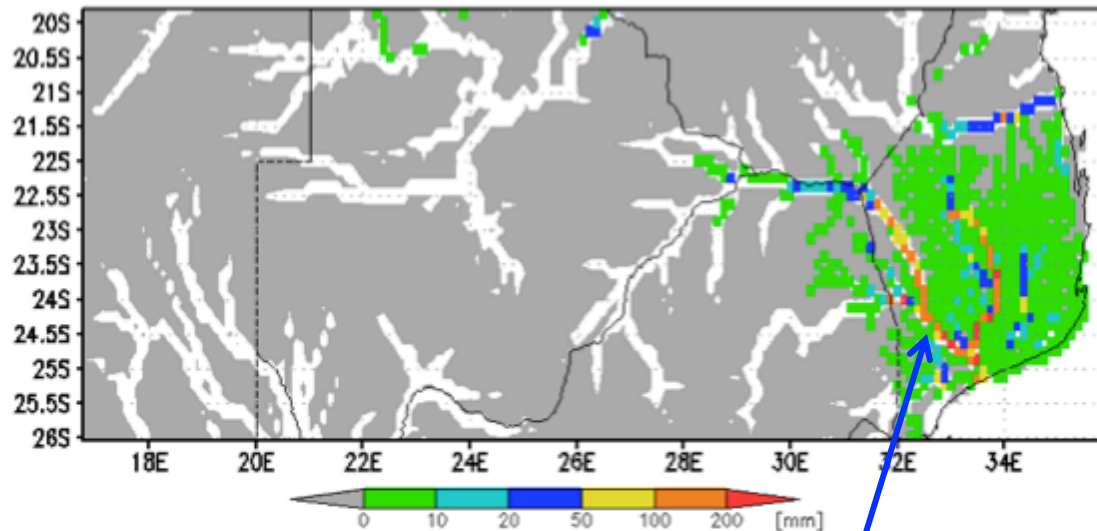
Mozambique, January 2013

TRMM and Multi-satellite
Precipitation (TMPA), surface
temperature and winds from
MERRA
Used in a hydrology model

Streamflow
monitoring
and
Flood Detection



Flood Detection/Intensity (Depth above Threshold [mm])



Detection of Flooding
in Mozambique

21 January 2013
12 GMT

Limpopo River Flooding

TRMM near-real Time and Accumulated Rainfall

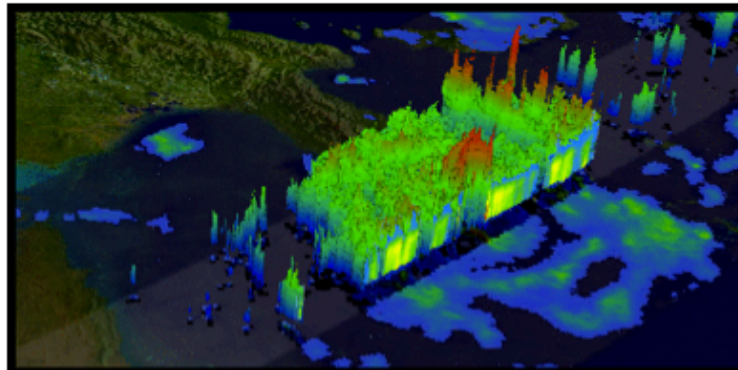
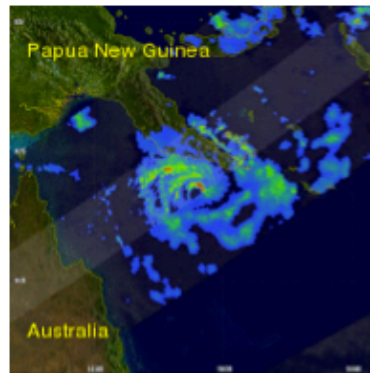
Monitoring Tropical Cyclone Intensity

Thursday April 10, 2014

Tropical Cyclone ITA Becomes More Powerful

Tropical cyclone ITA, located in the Coral Sea northeast of Australia, continues to intensify while heading toward the northeastern coast of Australia. ITA was seen twice by the TRMM satellite on April 9, 2014. The tropical cyclone's wind speeds had increased from 65kts (about 75 mph) with the first pass at 0536 UTC to 80kts (about 92 mph) when viewed again at 1528 UTC. ITA is predicted to continue becoming more powerful and have sustained winds of 135 kts (about 188 mph) before hitting Australia's Queensland coast tomorrow.

Tropical cyclone ITA's rainfall at 1528 UTC is shown here courtesy of TRMM's Microwave Imager (TMI) and Precipitation Radar (PR) instruments. The area of PR coverage is shown in a slightly lighter shade. TRMM PR data showed that a maximum rainfall rate of almost 163 mm/hr (about 6.4 inches) was located in the eastern side of ITA's eye wall.



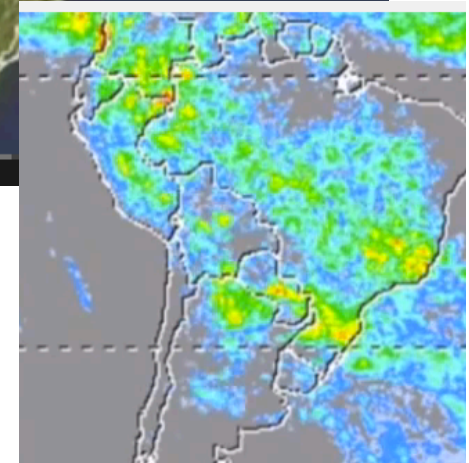
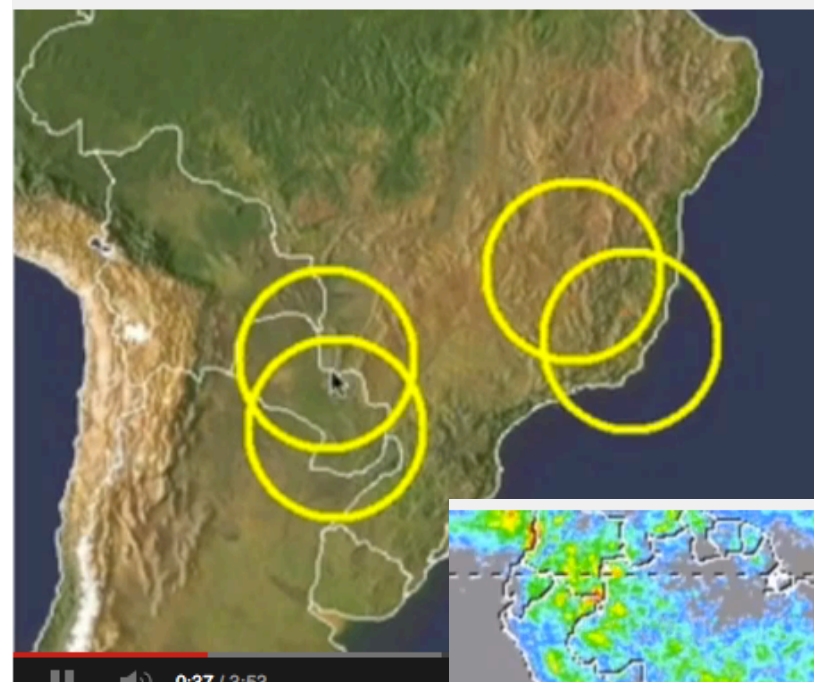
TRMM's Precipitation Radar (PR) instrument sliced through ITA's eye and those data were used in this 3-D "cut-a-way" view. Powerful storms in ITA's eye wall were found to reach heights of over 14km (about 8.7 miles). The tallest thunderstorm towers shown here were reaching heights of over 16 km (about 9.9 miles) in a feeder band well to the northeast of ITA's eye.

<http://trmm.gsfc.nasa.gov>

/

Landslide Potential

December 9, 2013
Landslide over Brazil



<https://www.youtube.com/watch?v=TfVlz7-x4TE>

Land Information System and Soil Moisture Applications

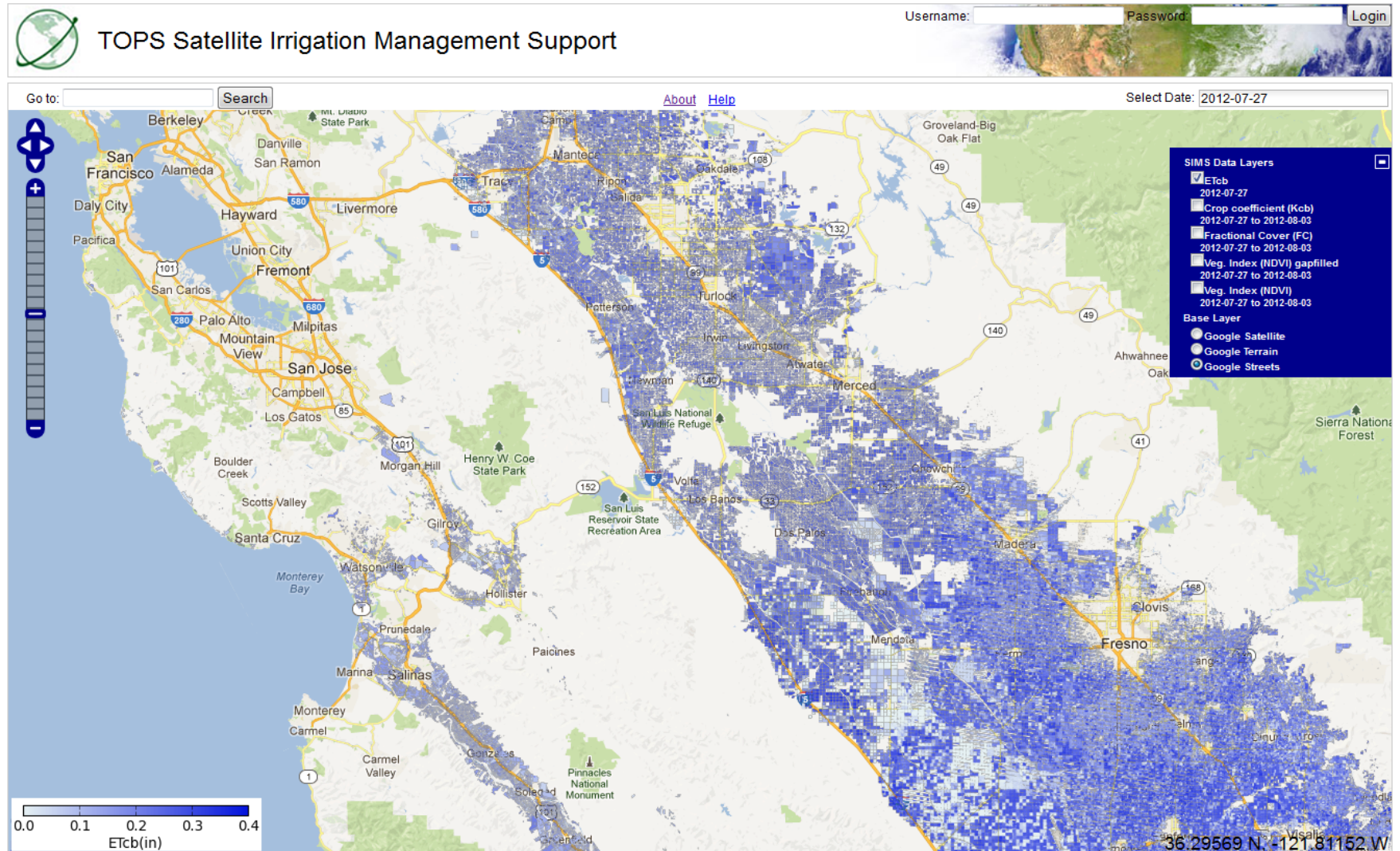
Water resources:	Regional water balance and effective governance
Natural Disaster:	Drought early warning and decision support, Improved flood forecasting and mapping, soil infiltration condition
Agriculture:	Prediction of agricultural productivity (USDA), famine early warning, crop monitoring
Weather:	More accurate rainfall prediction

<https://c3.nasa.gov/water/projects/>
<http://smap.jpl.nasa.gov/applications/>

Landsat-Evapotranspiration-used for Irrigation management over central California

Economic benefits by conservation of water and energy

<http://www.ecocast.org/dgw/sims>



**Monitoring Near-real Time and Seasonal Rainfall
from TRMM over Nile River Basin
(major component of freshwater budget)
Using Giovanni**

Live demonstration of getting data from Giovanni for

- *visual monitoring*
- *downloading digital data to use in decision support models or tools*

Giovanni

GES DISC: Goddard Earth Sciences, Data and Information Services Center



<http://disc.sci.gsfc.nasa.gov/giovanni>

[GES DISC Home](#) [Data Services](#) [Science Portals](#) [Mission Portals](#)

Atmos Composition Hydrology Precipitation Ozone MAIRS More...

Giovanni - The Bridge Between Data and Science

» OVERVIEW

- + What is Giovanni?
- + Who Uses Giovanni?
- + Giovanni Parameters
- + Giovanni Plot Types
- + How to Use Giovanni
- + How to Acknowledge Giovanni
- + Acknowledgements

You are here: [GES DISC Home](#) » Giovanni - Interactive Visualization and Analysis

Giovanni - Interactive Visualization and Analysis

Contributors: tonyr, rchowdhury

Giovanni - Interactive Visualization and Analysis - GES DISC: Goddard Earth Sciences, Data and Information Services Center

Giovanni-4 Now Available

New! Please try out [Giovanni-4](#), the next generation of [Giovanni](#), with dramatically improved performance and interactive plotting and mapping. (Currently, only select Aerosols, Hydrology and Turbulent Flux data are available in Giovanni-4, with more on the way.)

▼ Atmospheric Portals (Scroll down to view complete list)

- [A-Train along CloudSat Track](#)
- [Aerosols Express \(powered by Giovanni-4\)](#)
- [MAPPS Statistical Explorer](#) **NEW**
- [MAPSS: Multi-sensor Aerosol Products Sampling System](#)
- [AeroStat: Aerosol data measured by satellites and Aeronet stations](#)
- [Aerosol Optical Thickness Measurement and Model Comparison: Daily](#)
- [Aerosol Optical Thickness Measurement and Model Comparison: Monthly](#)
- [MISR Daily](#)
- [MISR Monthly](#)

► Application and Education Portal (Scroll down to view complete list)

► Meteorological Portals

► Ocean Portals

► Hydrology Portals (Scroll down to view complete list)

Hydrology Portal

TRMM Rainfall and GLDAS/NLDAS Data

Giovanni Portals **Giovanni Parameter List**

- ▶ **Atmospheric Portals** (Scroll down to view complete list)
- ▶ **Application and Education Portal** (Scroll down to view complete list)
- ▶ **Meteorological Portals**
- ▶ **Ocean Portals**
- ▼ **Hydrology Portals** (Scroll down to view complete list)

■ [TRMM Online Visualization and Analysis System \(TOVAS\)](#)

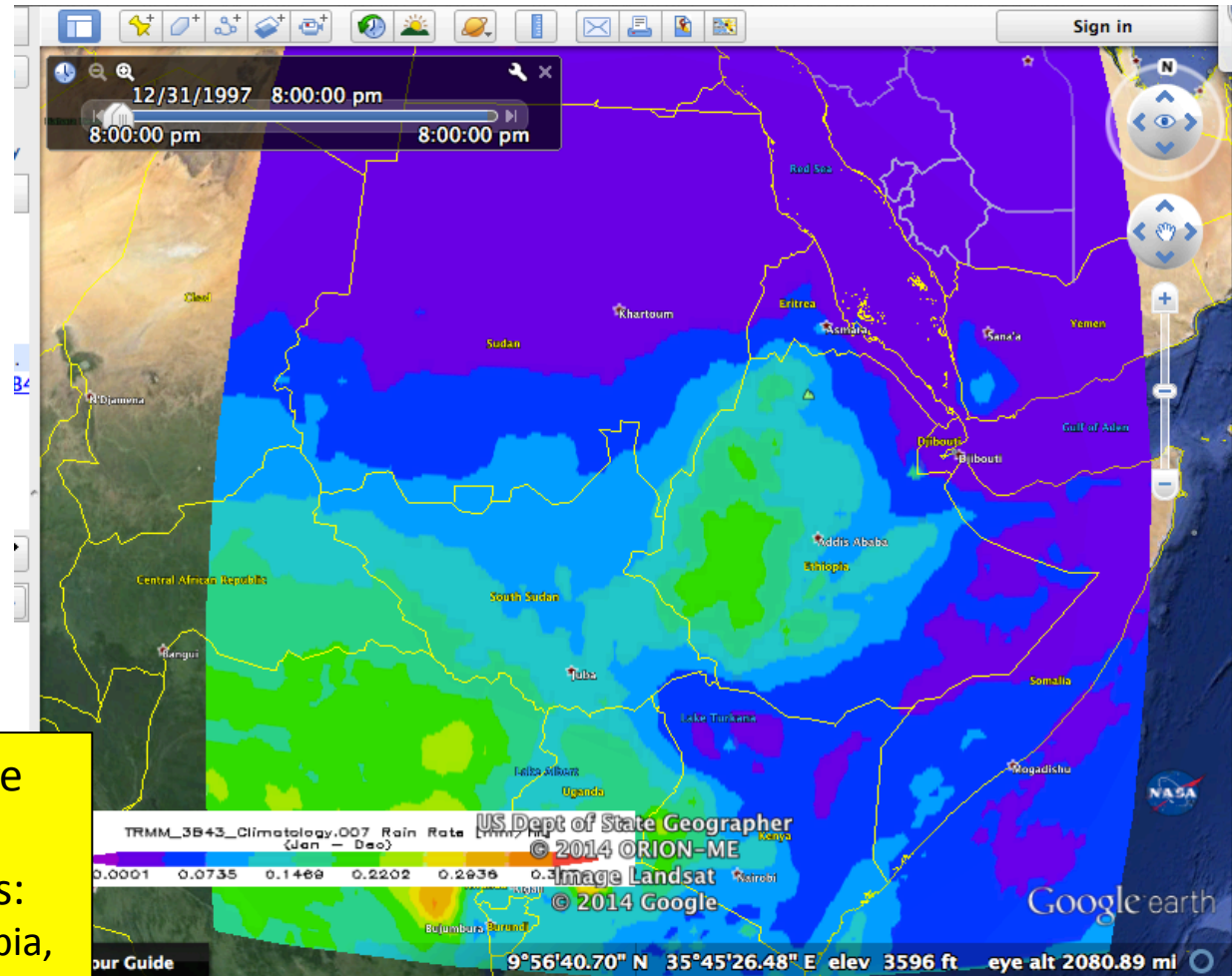
▶ **Near-Real-Time Monitoring Product (For research, use Archive Data)**
Experimental Real-Time TRMM Multi-Satellite Precipitation Analysis (TMPA-RT): 3B42RT
Daily Global and Regional Rainfall (3B42RT derived)
TMPA-RT Intermediate IR Product: 3B41RT (VAR)
TMPA-RT Intermediate Microwave Product: 3B40RT (HQ)

▶ **Satellite Rainfall Archives**
Monthly Global Precipitation (GPCP)
3-hourly TRMM and Other Rainfall Estimate (3B42 V7)
Daily TRMM and Other Rainfall Estimate (3B42 V7 derived)
Monthly TRMM and Other Data Sources Rainfall Estimate (3B43, 3A12, 3A25 V7)

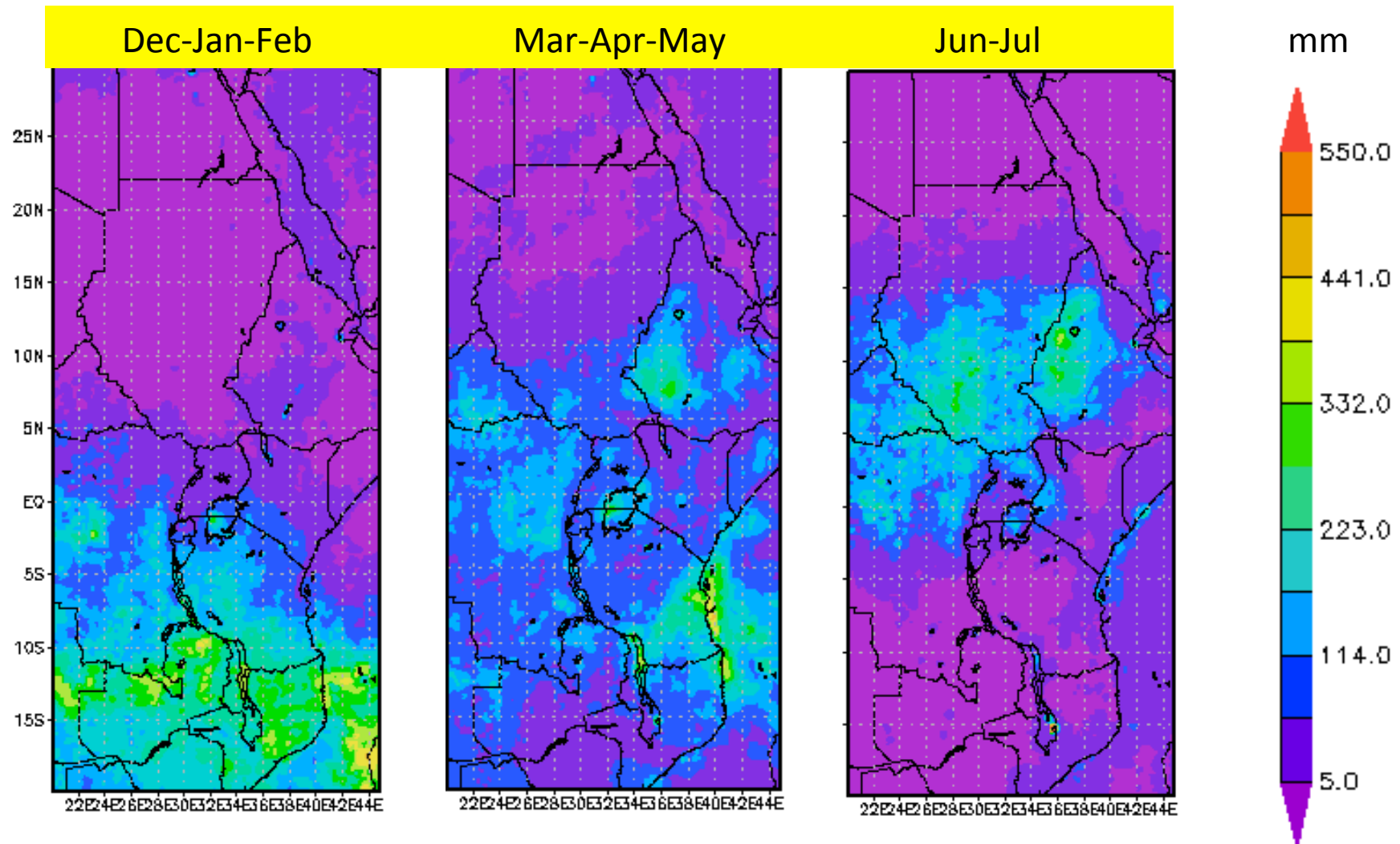
Data Parameters

Nile Basin

Mean rain rate from TRMM (1998-2013)



Seasonal Accumulated Rainfall over Nile River Basin in 2014



Drought Monitoring over Western US using NLDAS Modeling Data

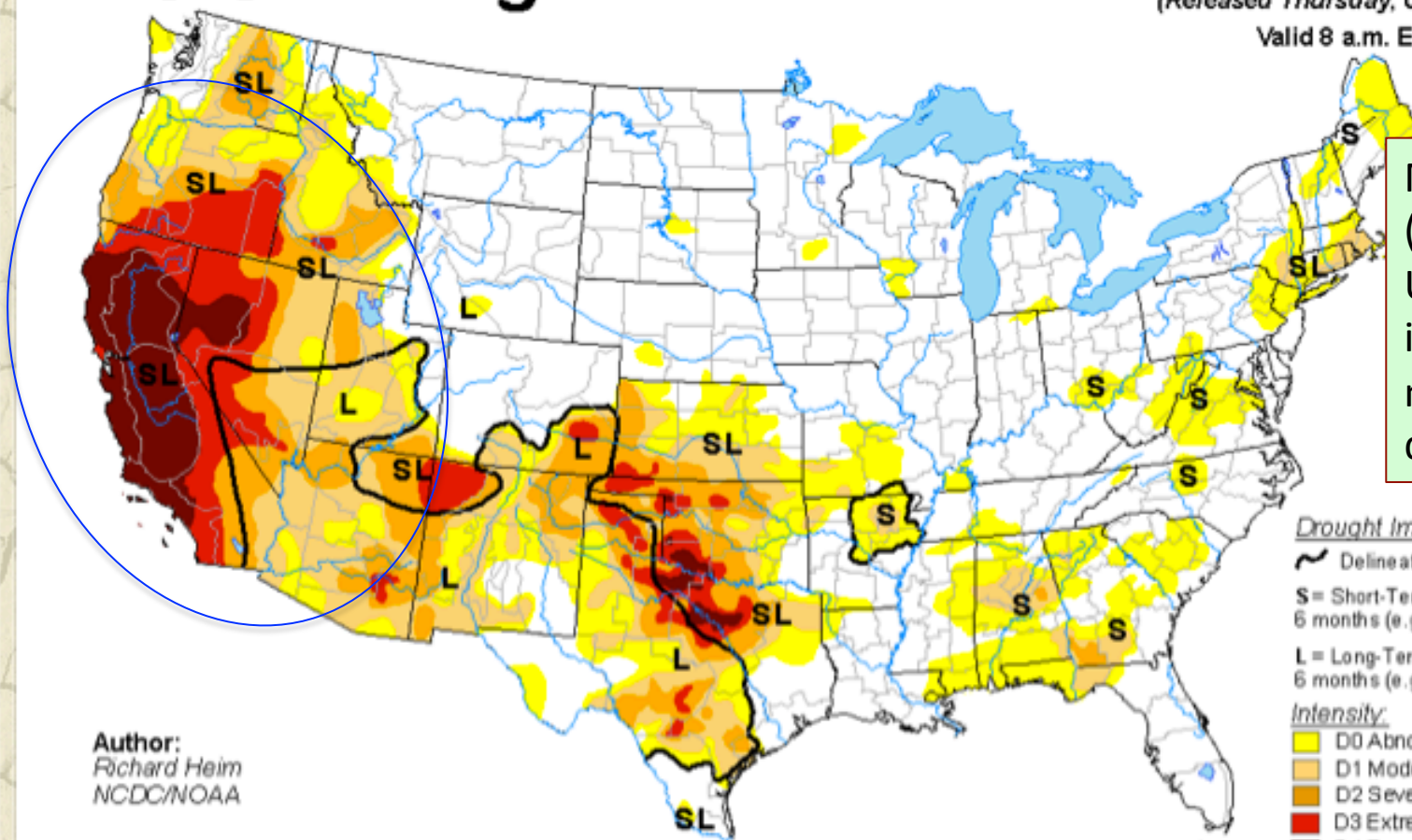
Current Condition: California Drought Continues

U.S. Drought Monitor

September 30, 2014

(Released Thursday, Oct. 2, 2014)

Valid 8 a.m. EDT



Multi-agency (NOAA, USGS, USDA), Multi-data indicators used for mapping weekly drought conditions

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Drought Impact Types:

~ Delineates dominant impacts

S = Short-Term, typically less than 6 months (e.g. agriculture, grasslands)

L = Long-Term, typically greater than 6 months (e.g. hydrology, ecology)

Intensity:

D0 Abnormally Dry

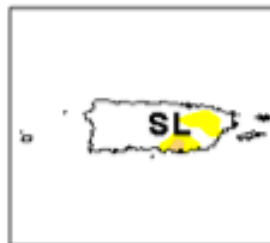
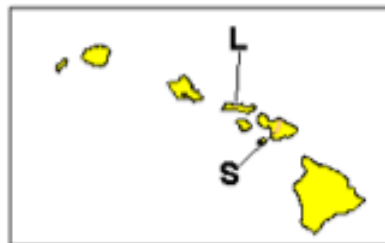
D1 Moderate Drought

D2 Severe Drought

D3 Extreme Drought

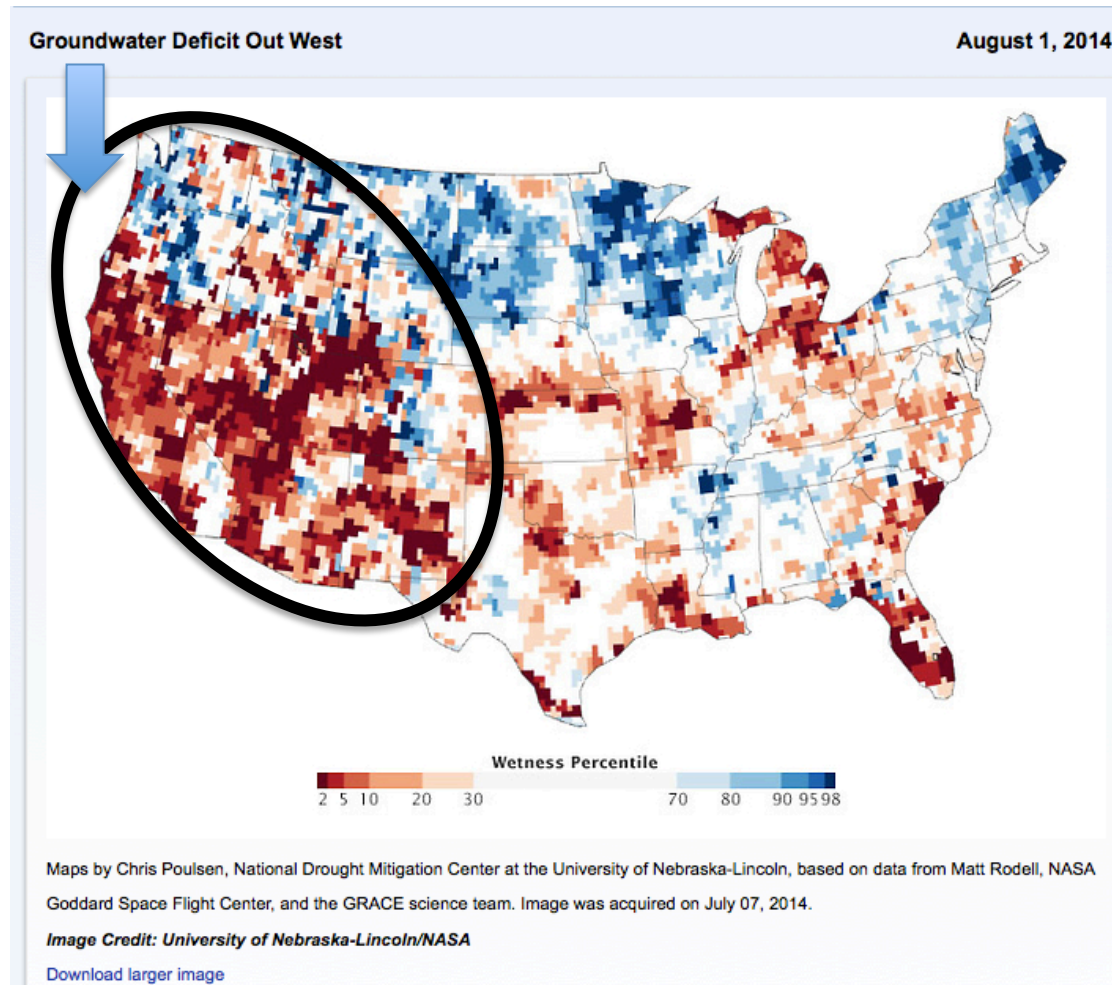
D4 Exceptional Drought

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.



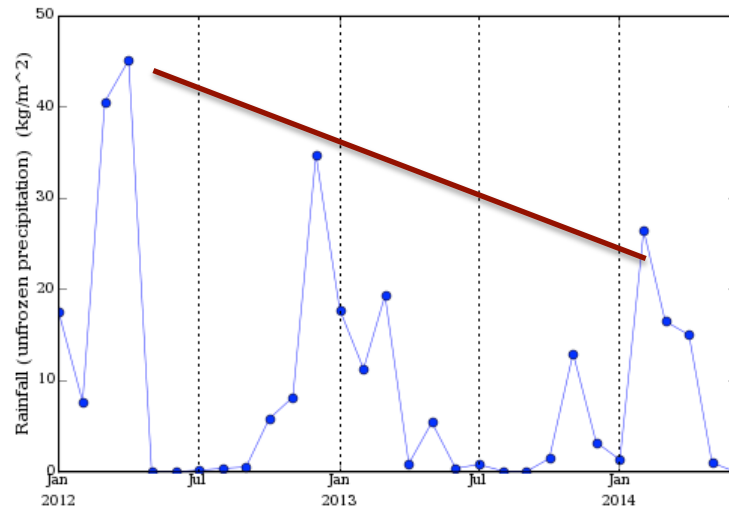
<http://droughtmonitor.unl.edu/>

Ground Water Deficit Monitored from GRACE Satellite also Shows Hydrological Drought over California



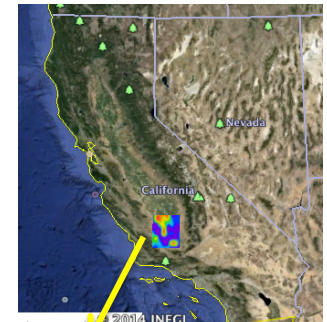
Used by National Drought Mitigation Center to Monitor Hydrological Drought

NLDAS Rain Fall

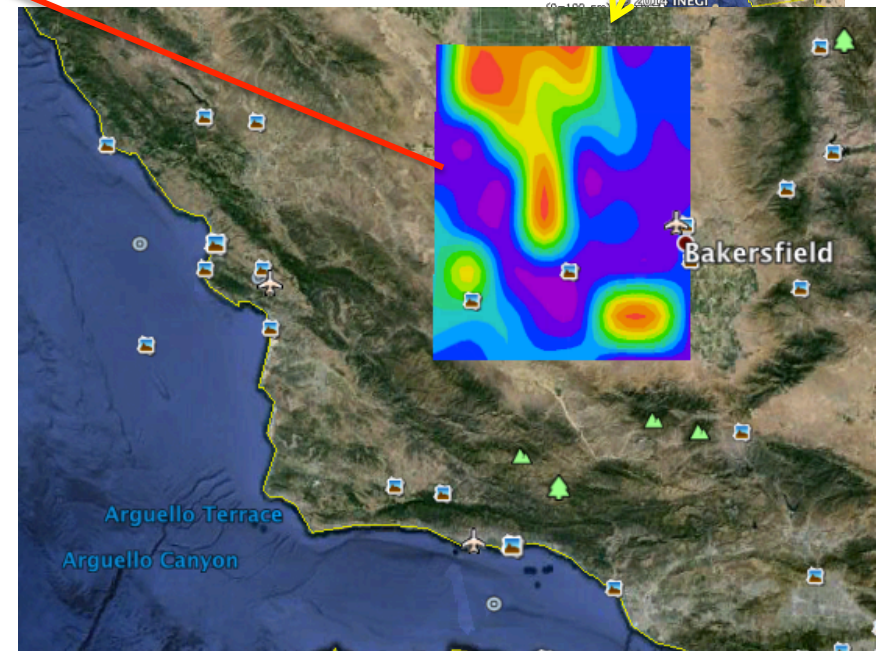
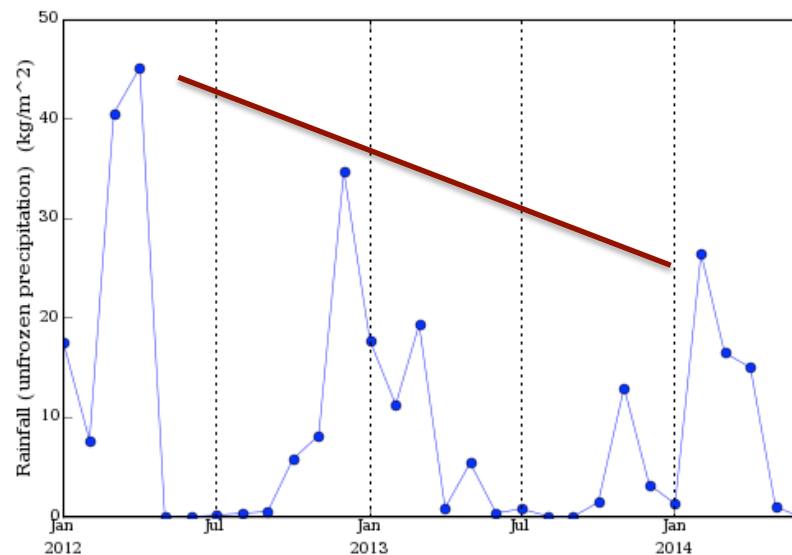


Worsening meteorological and hydrological drought over California

Decreasing rainfall and soil moisture over south-central California

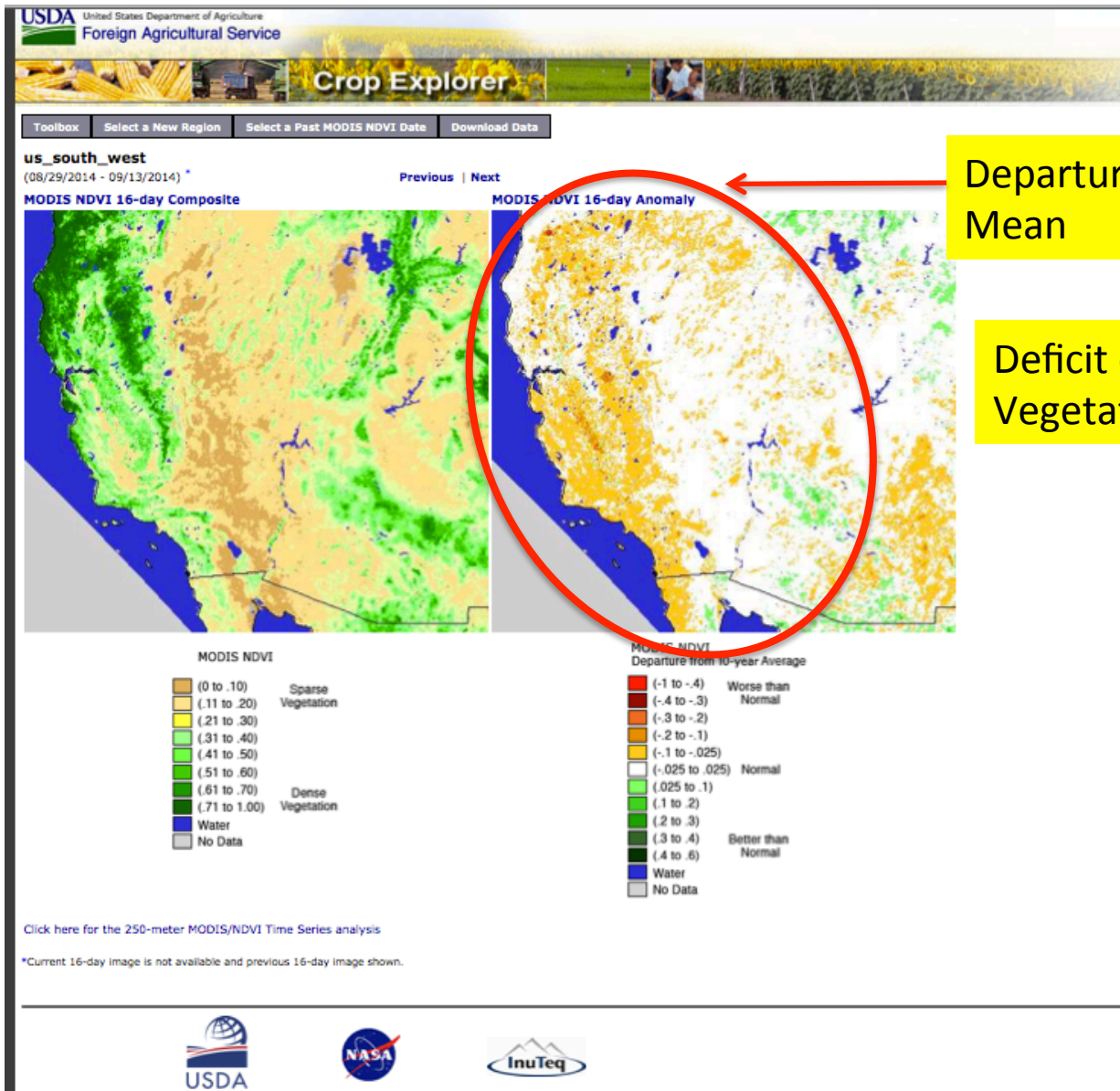


NLDAS Soil Moisture (0-100 cm)



Agricultural Drought Monitoring from MODIS

http://www.pecad.fas.usda.gov/cropexplorer/modis_ndvi/modis_ndvi.aspx?regionid=us&ndvi_folder=us_south_west



Departure from 10-year Mean

Deficit of Vegetation

**Live Demo : Giovanni to Access, Analyze,
Visualize Water Budget Components**

Live Demo

**Data obtained from Giovanni can be easily imported into
GIS**

Example of Rainfall over Nile River Basin

Coming Up Next Week --

**Live Demonstration of Case Studies
Data Access and Analysis for Disaster
Monitoring and Land Resources Applications
with GIS**

Thank You!